

Technical Memorandum: Benefit-Cost Analysis of the North Carolina Rural Transit Facilities Program

Date: October 12, 2017

Subject: Benefit-Cost Analysis for the North Carolina Rural Transit Facilities Program

Project Description

North Carolina's Public Transportation Division, in partnership with county and private non-profit transit agencies, provides demand response transportation services to rural North Carolina residents whose disability prevents them from riding fixed-route public transportation (when available), older residents typically over 60 or 65 years who may no longer have access to independent transportation, as well as residents who participate in various human service or grant programs. Put simply, demand response transit service is a mobility safety net. Demand response transit uses vans or small buses operating in response to calls made to a transit operator from passengers or their agents. The operator schedules and dispatches a vehicle to pick up and transport passengers to their destinations.

The provision of rural public transit comprises three interconnected activities: 1) operation of the van fleet carrying passengers; 2) garage maintenance; and 3) the less-visible, but essential, operations, scheduling and dispatch of trips. Each of the components is required to provide safe and reliable service to the region's passengers. The Rural Transit Facilities TIGER Project will construct or expand six (6) demand response transit operations centers in six rural counties in North Carolina. These are Anson, Duplin, Hoke, Iredell, Johnston, and Macon Counties, shown in Exhibit 1. This project is scalable; each individual facility has independent utility. This TIGER project will construct modern purpose-built transit facilities in six rural locations across North Carolina, enabling these systems to provide higher quality reliable transit service at a lower cost.

Exhibit 1 – Potential Project Locations



At present, each county system is performing these functions from a variety of locations that they have been able to incrementally secure as the systems were established and grew. Exhibit 2 summarizes the existing conditions for each of the systems.

Exhibit 2 - Status of Current County Facilities

| County Transit System | Status of Current Facilities |
|-----------------------|--|
| Anson | Operations and administration staff works from a leased building built in 1975 with poor insulation. Building is not energy efficient. It is located on a busy highway and staff vehicles have been involved in accidents getting into and out of the parking area. Vehicle circulation on the site is inadequate for efficient dispatch and circulation; vehicles must go offsite to be washed. Staff must go offsite for training as there is no room onsite. |
| Duplin | Current administration site has inadequate space and parking with administration, parking and washing activities and IT services distributed across several locations. Drivers must clock in at one location and then drive to where vans are parked. Admin staff must find parking offsite. Vehicles are parked off site near psychiatric hospital; drivers sometimes face uncomfortable situations and are told to call sheriff for escort. Vans are washed with a hose by drivers at a senior center in a small parking lot that makes moving vehicles while washing others dangerous. |
| Hoke | Currently working out of a shared space with the County's Department of Social Services in a 1,200 square foot facility. There is inadequate space to perform administrative duties, and inadequate space for cleaning, parking, and storing of vehicles. The break area is not adequately sized to accommodate staff. Cleaning supplies to support vehicle washing are stored in the foyer. Site circulation is challenging and transit vehicles are often stacked in front of personal vehicles due to lack of space. Vehicle routes have been lengthened to avoid a number of flat-tire incidents due to a nearby metal works site. |
| Iredell | Currently working from a residential structure. House was built in 1970s and condemned in 2002. Space is inadequate. Approximately 46 people work shifts in the building; and there is one bathroom. Four dispatchers work out of the two-car garage. Building is not energy efficient. |
| Johnston | Service works out of two mobile units with a combined space of 2,000 square feet. The fire marshal will not permit all employees to work at the location at the same time for safety reasons. There is no room for daily safety briefings on site. Meetings and trainings must be held off-site. Demand for the system/service is growing and there is no room to accommodate additional dispatch and operations staff. |
| Macon | The current facility was built in 2003 and, due to greater than anticipated growth, has become inadequate for their services. The 1,200 square foot expansion would add a conference/training room, storage, and a director's office. The expansion would allow for more efficient management of services and fleet while accommodating the expected growth in ridership. The expansion would also provide office space for the hiring of a Mobility Manager who would work with Macon County Transit and a neighboring system. |

As noted, most of these systems have been forced to acquire space across a variety of locations to support their operations. Consolidating these facilities into a single location would provide the greatest operational efficiency, reduce deadhead costs, and maximize passenger fleet use.

In addition, many of the facilities are at or near capacity and unable to accommodate anticipated future demand. This means that the County facilities will need to transfer operations to facilities that can not only provide space for additional revenue vehicles, but that are ideally located and designed to minimize deadheading and inefficiency costs. Deadheading costs are incurred

because operational functions are currently located in multiple locations. Furthermore, inefficiency costs are incurred because existing facilities are not designed in a way that compliments the needs of a demand response transit service program.

Constructing new or expanding existing facilities is the best way to guarantee the future success of these systems. Owning a facility makes it an asset on the agency's balance sheet. Owned facilities can be tailored to fit both the County transit system's current and future needs in order to improve operational efficiency and to accommodate future demand. Furthermore, leasing facilities makes these systems vulnerable if the landlord were to sell the property. This would force the transit provider to quickly find another location to support operations. The system might not be able to find a new, suitable location, which could potentially further increase operating, administrative, and deadheading costs.

Despite the cost of purchasing, expanding, and operating six new operations facilities, each system will see a positive return on investment. But this is not just about cost. If each of the County demand response providers owns the facilities, it can safely invest in and improve the facilities without the risk of stranding the investment if the landlord changes the lease or decides to sell.

There is a strong business case for constructing consolidated facilities built for the purpose of operating and administering community transit service. Such an approach will save each agency money, allow it to provide quality service, and is readily implementable. Key points include:

- Each county agency could save resources and the size of the savings would grow over time with the expansion of the program,
- Ownership and control of the operations and administration facilities would support the provision of reliable and quality service,
- The cost of poorly designed facilities relative to customer demand is a particularly large burden on the programs—the cost of 2.5 deadheading miles approximately equals the maximum fare, and
- Each of the County service providers retains future investment made in facilities over time.

Facilities that do not fully accommodate the County transit service program needs can still be utilized as they are now, but doing so requires a “work around” that imposes a cost on operations. For example, vehicles assigned to dispatch facilities that lack on-site washing capabilities must be driven to an off-site location for cleaning—adding miles to the vehicles while consuming fuel and employee time. There are also costs associated with the physical layout of individual facilities. Examples of such costs include the off-site washing and sometimes parking, operator skills training or meetings, lack of IT integration, inefficiencies related to the internal flow and vehicle pullout at the site, and congested operator dispatcher space.

Introduction

The North Carolina Rural Transit Facilities Program would provide new or upgraded administrative and operating facilities for six rural agencies in North Carolina serving demand response transportation. The Project provides local and regional benefits for both public and private stakeholders and improves each of the counties' abilities to serve its expanding customer base into the future.

New or expanded facilities for six rural North Carolina counties are included in this Program. A list of the counties and a brief description of the facilities includes:

- Anson County - construct new 3,482 SF facility to include administrative and operating space, parking, and wash bay on county-owned land

- Duplin County - construct new 3,323 SF facility to include administrative and operating space, parking, and wash bay on county-owned land
- Iredell County - construct new 7,200 SF facility to include administrative and operating space and parking on land that must be purchased
- Hoke County - construct new 3,500 SF facility to include administrative and operating space and parking on land that must be purchased
- Johnston County - construct new 7,200 SF facility to include administrative and operating space and parking on county-owned land
- Macon County - construct expansion of existing facility by 1,200 square feet to include administrative and operating space

This technical memorandum estimates the long-term benefits associated with the Project. The long-term benefits presented relate to the five (5) Long-Term Outcomes identified in the TIGER 2017 Notice of Funding Opportunity (NOFO)¹: State of Good Repair, Economic Competitiveness, Quality of Life, Environmental Sustainability, and Safety. The final section discounts the stream of anticipated benefits and costs and calculates the Benefit Cost Ratios for the Project at 7 percent and 3 percent.

The Project described in this application would support the region's economy over the long-term by providing the workforce and residents of the six rural counties with improved demand response transit operations. As such, the facilities will allow dispatchers, administrative personnel, and drivers adequate workspace including desk space, break rooms, lockers, bathrooms, storage, and parking for transit vehicles. The modern, energy-efficient facilities will be located in safer areas that will save marginal vehicle miles traveled, thereby improving safety, congestion, vehicle and pavement maintenance, and emissions in the region. Without the new or expanded facilities, the systems would continue to turn away riders to other services, thereby incurring higher operating costs than if the customers were served in-house. As a result, the new facilities therefore allow the counties to save on ongoing operating costs and to accommodate the growing rural elderly ridership base.

The impact matrix is presented in Exhibit 3.

¹See TIGER 2017 Notice of Funding Opportunity,
<https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/tiger/114796/fy17-tiger-fedreg.pdf>

Exhibit 3 – Impact Matrix for the Six Facility Program

| Current Status/Baseline & Problem to be Addressed | Change to Baseline or Alternatives | Types of Impacts | Affected Population | Economic Benefit (Net Present Values, \$2017 M) | | Page Reference in BCA |
|--|---|--|----------------------------------|---|------------------|-----------------------|
| | | | | Discounted at 7% | Discounted at 3% | |
| Currently, the six transit agencies are operating in inefficient, old, and inadequate facilities. Ridership is increasing, and the need for more efficient dispatching, administration, and vehicle operation is growing. Agencies must pay leases, make longer trips than necessary due to inefficient operations, and pay other operators to serve trips that they cannot accommodate. | With new facilities, the transit agencies will have adequate space to accommodate existing staff and hire additional staff, serve existing and new customers, and operate the fleet more efficiently. | Safety: | | | | |
| | | Reduced Roadway Fatalities and Crashes | Remaining drivers on local roads | \$0.51 | \$0.85 | 10 |
| | | State of Good Repair: | | | | |
| | | Roadway Maintenance Savings | NCDOT Taxpayers | \$0.29 | \$0.47 | 12 |
| | | Residual Value | Transit operator Taxpayers | \$1.65 | \$2.57 | 12 |
| | | Environmental Sustainability: | | | | |
| | | Emissions Savings | All residents | \$0.02 | \$0.03 | 13 |
| | | Economic Competitiveness: | | | | |
| | | Costs of Trips Turned Away | Transit operator Taxpayers | \$6.74 | \$10.90 | 13 |
| | | Lease Avoided | Transit operator Taxpayers | \$0.43 | \$0.68 | 14 |
| | | Dispatch Efficiency | Transit operator Taxpayers | \$0.13 | \$0.20 | 14 |
| | | Wash Savings | Transit operator Taxpayers | \$0.32 | \$0.50 | 14 |
| | | Congestion Savings | Remaining drivers on local roads | \$0.22 | \$0.35 | 15 |
| | | Vehicle Operating Cost Savings | Transit operator Taxpayers | \$4.09 | \$6.62 | 15 |

| | | | | | |
|--|--|--------------------|------------------|-------------------------|----|
| | | Quality of Life: | | | |
| | | Adequate Workspace | Transit operator | Qualitatively described | 15 |
| | | Safety at Work | Transit operator | | 15 |

The balance of this discussion describes the assumptions and methods used to develop the benefit-cost analysis and estimates the value of the long-term benefits generated by the investment. The useful life of the capital investment has been estimated over a 20-year analysis horizon.

The Program (all facilities) would be constructed by December of 2020, and a benefits period of 2021-2040 was used. The stream of benefits and costs over time are converted to the present value using the required 7 percent discount rate. The equivalent results also are shown at a 3 percent discount rate. All benefits are estimated in accordance with guidance provided by US Department of Transportation (USDOT) for benefit-cost analysis. If no USDOT guidance was available for the estimate, the Project team consulted industry research for the best practice and information on which to base the assumptions and methodology.

The total benefits quantified in the benefit-cost analysis for the six facilities in aggregate are described in the following pages in 2017 dollars. The total results and those for the individual county facilities are presented in the Summary section.

Analysis Assumptions

A list of assumptions for the project is provided in the BCA workbook (see Inputs tab in the file NCDOT_PTD_TIGER2017) as well as in Exhibit 4.

Exhibit 4 - BCA Calculation Inputs

| Input | Value | Source |
|-------------------------------|----------------------|---|
| General | | |
| Discount Rate | 7% | 2017 TIGER BCA Resource Guide |
| Discount Rate | 3% | 2017 TIGER BCA Resource Guide |
| Deflator | See "Deflator" Sheet | https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/budget/fy2018/hist10z1.xls |
| Estimated Facility Sizes (SF) | | |
| Anson County | 3,482 | NCDOT PTD |
| Duplin County | 3,323 | NCDOT PTD |
| Hoke County | 3,500 | NCDOT PTD |
| Iredell County | 7,200 | NCDOT PTD |
| Johnston County | 7,200 | NCDOT PTD |
| Macon County | 1,200 | NCDOT PTD |
| Average Hourly Rate | | |
| Anson County | \$16.63 | Anson FY16 OpStats |
| Duplin County | \$19.01 | Duplin FY16 OpStats |
| Hoke County | \$17.86 | Hoke FY16 OpStats |
| Iredell County | \$17.39 | Iredell FY16 OpStats |
| Johnston County | \$18.46 | Johnston FY16 OpStats |
| Macon County | \$16.30 | Macon FY16 OpStats |
| Vehicles | | |
| Anson County | 15 | Anson County |
| Duplin County | 14 | Duplin County |
| Hoke County | 21 | Hoke County |

| Input | Value | Source |
|--|----------|--|
| Iredell County | 33 | Iredell County |
| Johnston County | 31 | Johnston County |
| Macon County | 16 | Macon County |
| Rate of Annual Growth (CAGR) | | |
| Anson County | 1.01% | UNC Demography, http://demography.cpc.unc.edu/2013/10/14/population-growth-population-aging-in-north-carolina-counties/ |
| Duplin County | 2.29% | UNC Demography, http://demography.cpc.unc.edu/2013/10/14/population-growth-population-aging-in-north-carolina-counties/ |
| Hoke County | 3.14% | UNC Demography, http://demography.cpc.unc.edu/2013/10/14/population-growth-population-aging-in-north-carolina-counties/ |
| Iredell County | 2.18% | UNC Demography, http://demography.cpc.unc.edu/2013/10/14/population-growth-population-aging-in-north-carolina-counties/ |
| Johnston County | 2.69% | UNC Demography, http://demography.cpc.unc.edu/2013/10/14/population-growth-population-aging-in-north-carolina-counties/ |
| Macon County | 1.12% | UNC Demography, http://demography.cpc.unc.edu/2013/10/14/population-growth-population-aging-in-north-carolina-counties/ |
| | | |
| State of Good Repair | | |
| Operating cost per mile for all modes | | |
| Anson County | \$1.62 | Anson FY16 OpStats |
| Duplin County | \$0.81 | Duplin FY16 OpStats |
| Hoke County | \$1.55 | Hoke FY16 OpStats |
| Iredell County | \$1.37 | Iredell FY16 OpStats |
| Johnston County | \$1.27 | Johnston FY16 OpStats |
| Macon County | \$1.32 | Macon FY16 OpStats |
| Roadway Maintenance Cost (1990\$/mi) | \$0.08 | Calculated from: http://www.its.ucdavis.edu/research/publications/publication-detail/?pub_id=19 |
| Roadway Maintenance Cost per Mile (Pavement, etc.) (2017\$/Mile) | \$0.14 | Adjusted by GDP Deflator |
| | | |
| Economic Competitiveness | | |
| Congestion Cost per VMT (2000\$) | \$0.08 | http://www.fhwa.dot.gov/policy/hcas/addendum.htm |
| Congestion Cost per VMT (2017\$) | \$0.11 | http://www.fhwa.dot.gov/policy/hcas/addendum.htm , Adjusted by GDP Deflator |
| | | - |
| Avoided lease/mortgage costs | | - |
| Anson County | \$22,560 | Anson County, annual rent, increasing by 5% per year |
| Duplin County | \$0 | Duplin County, county owned |
| Hoke County | \$0 | Hoke County, county owned |
| Iredell County | \$25,000 | Iredell County, \$250,000 purchase price over 10 years. Assumed start in year 1. |

| Input | Value | Source |
|--|-------------|---|
| Johnston County | \$0 | Johnston County, county owned |
| Macon County | \$0 | Macon County, county owned |
| | | |
| Environmental Sustainability | | |
| VOC Value of Emissions (2016\$) per short ton | \$1,872 | 2017 TIGER BCA Resource Guide |
| NOx Value of Emissions (2016\$) per short ton | \$7,377 | 2017 TIGER BCA Resource Guide |
| PM Value of Emissions (2016\$) per short ton | \$337,459 | 2017 TIGER BCA Resource Guide |
| SOx Value of Emissions (2016\$) per short ton | \$43,600 | 2017 TIGER BCA Resource Guide |
| VOC Value of Emissions (2017\$) per short ton | \$1,906 | 2017 TIGER BCA Resource Guide, Adjusted by GDP Deflator |
| NOx Value of Emissions (2017\$) per short ton | \$7,512 | 2017 TIGER BCA Resource Guide, Adjusted by GDP Deflator |
| PM Value of Emissions (2017\$) per short ton | \$343,654 | 2017 TIGER BCA Resource Guide, Adjusted by GDP Deflator |
| SOx Value of Emissions (2017\$) per short ton | \$44,400 | 2017 TIGER BCA Resource Guide, Adjusted by GDP Deflator |
| Passenger Car Emission Rates per Mile, VOC, 2013-2024 | 0.6 | http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf |
| Passenger Car Emission Rates per Mile, NOx, 2013-2024 | 0.91 | http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf |
| Passenger Car Emission Rates per Mile, PM25, 2013-2024 | 0.01 | http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf |
| Passenger Car Emission Rates per Mile, CO2, 2013-2024 | 532 | http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf |
| Passenger Car Emission Rates per Mile, VOC, 2025-2034 | 0.27 | http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf |
| Passenger Car Emission Rates per Mile, NOx, 2025-2034 | 0.28 | http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf |
| Passenger Car Emission Rates per Mile, PM25, 2025-2034 | 0.01 | http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf |
| Passenger Car Emission Rates per Mile, CO2, 2025-2034 | 434 | http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf |
| Passenger Car Emission Rates per Mile, VOC, 2035- | 0.21 | http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf |
| Passenger Car Emission Rates per Mile, NOx, 2035- | 0.2 | http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf |
| Passenger Car Emission Rates per Mile, PM25, 2035- | 0.01 | http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf |
| Passenger Car Emission Rates per Mile, CO2, 2035- | 397 | http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf |
| Conversion rate for Metric tons to Short Tons | 1.1015 | 2017 TIGER BCA Resource Guide |
| | | |
| Safety | | |
| AIS 0 (2016\$) per vehicle | \$4,252 | 2017 TIGER BCA Resource Guide |
| AIS 1 (2016\$) | \$28,800 | 2017 TIGER BCA Resource Guide |
| AIS 2(2016\$) | \$451,200 | 2017 TIGER BCA Resource Guide |
| AIS 3(2016\$) | \$1,008,000 | 2017 TIGER BCA Resource Guide |
| AIS 4(2016\$) | \$2,553,600 | 2017 TIGER BCA Resource Guide |
| AIS 5(2016\$) | \$5,692,800 | 2017 TIGER BCA Resource Guide |

| Input | Value | Source |
|----------------------------|-------------|---|
| AIS 6(2016\$) | \$9,600,000 | 2017 TIGER BCA Resource Guide |
| AIS 0 (2017\$) per vehicle | \$4,330 | 2017 TIGER BCA Resource Guide, Adjusted by GDP Deflator |
| AIS 1 (2017\$) | \$29,329 | 2017 TIGER BCA Resource Guide, Adjusted by GDP Deflator |
| AIS 2 (2017\$) | \$459,483 | 2017 TIGER BCA Resource Guide, Adjusted by GDP Deflator |
| AIS 3 (2017\$) | \$1,026,505 | 2017 TIGER BCA Resource Guide, Adjusted by GDP Deflator |
| AIS 4 (2017\$) | \$2,600,480 | 2017 TIGER BCA Resource Guide, Adjusted by GDP Deflator |
| AIS 5 (2017\$) | \$5,797,311 | 2017 TIGER BCA Resource Guide, Adjusted by GDP Deflator |
| AIS 6 (2017\$) | \$9,776,242 | 2017 TIGER BCA Resource Guide, Adjusted by GDP Deflator |

Benefits

Safety

Reduced Highway Fatalities and Crashes

The new and expanded facility locations will save marginal vehicle miles traveled (VMT) for the transit vehicles through more efficient operations. The VMT saved are shown in Exhibit 5 and grow based on the expected change in the respective county's elderly population as shown in Exhibit 4. The reduced VMT are based on small mileage changes due to improved cite circulation and operations, and are estimated by the agencies on average to be 6 miles per vehicle per day.

Exhibit 5 – Annual Vehicle Miles Traveled Avoided per Facility

| | Total Project | Anson | Duplin | Hoke | Iredell | Johnston | Macon |
|--------------|----------------------|----------------------|----------------|------------------|------------------|----------------|----------------|
| Year | Reduced VMT (Annual) | Reduced VMT (Annual) | | | | | |
| 2021 | 197,600 | 23,400 | 21,840 | 43,680 | 51,480 | 32,240 | 24,960 |
| 2022 | 201,976 | 23,636 | 22,339 | 45,053 | 52,601 | 33,107 | 25,240 |
| 2023 | 206,460 | 23,874 | 22,850 | 46,469 | 53,746 | 33,997 | 25,523 |
| 2024 | 211,054 | 24,115 | 23,372 | 47,930 | 54,916 | 34,911 | 25,810 |
| 2025 | 215,762 | 24,358 | 23,906 | 49,437 | 56,112 | 35,850 | 26,099 |
| 2026 | 220,587 | 24,604 | 24,453 | 50,991 | 57,334 | 36,814 | 26,392 |
| 2027 | 225,531 | 24,852 | 25,012 | 52,594 | 58,582 | 37,803 | 26,688 |
| 2028 | 230,598 | 25,103 | 25,583 | 54,247 | 59,858 | 38,820 | 26,988 |
| 2029 | 235,791 | 25,356 | 26,168 | 55,953 | 61,161 | 39,863 | 27,290 |
| 2030 | 241,113 | 25,611 | 26,766 | 57,712 | 62,492 | 40,935 | 27,597 |
| 2031 | 246,568 | 25,870 | 27,378 | 59,526 | 63,853 | 42,036 | 27,906 |
| 2032 | 252,160 | 26,131 | 28,004 | 61,397 | 65,243 | 43,166 | 28,219 |
| 2033 | 257,891 | 26,394 | 28,644 | 63,327 | 66,664 | 44,327 | 28,536 |
| 2034 | 263,766 | 26,660 | 29,298 | 65,318 | 68,115 | 45,518 | 28,856 |
| 2035 | 269,789 | 26,929 | 29,968 | 67,371 | 69,598 | 46,742 | 29,180 |
| 2036 | 275,963 | 27,201 | 30,653 | 69,489 | 71,114 | 47,999 | 29,507 |
| 2037 | 282,292 | 27,475 | 31,354 | 71,674 | 72,662 | 49,289 | 29,838 |
| 2038 | 288,781 | 27,752 | 32,070 | 73,927 | 74,244 | 50,615 | 30,173 |
| 2039 | 295,433 | 28,032 | 32,803 | 76,251 | 75,861 | 51,976 | 30,512 |
| 2040 | 302,254 | 28,314 | 33,553 | 78,648 | 77,512 | 53,373 | 30,854 |
| Total | 4,921,370 | 515,666 | 546,014 | 1,190,993 | 1,273,149 | 839,380 | 556,167 |

The rates of crashes that result in fatalities, injuries, and property damage only are applied to the VMT avoided to derive the estimated crashes avoided from reduced VMT. To ensure consistency between the types of crashes, the crash rates for fatalities, injuries, and property damage only are the national average crash rates. These crash rates are shown in Exhibit 6.

Exhibit 6 - Crashes by Type per 100,000,000 VMT

| | Rate | |
|-----------------|-------------|---------------------|
| Fatalities | 1.133692236 | per 100,000,000 VMT |
| Injured persons | 78.92426005 | per 100,000,000 VMT |
| Crashes | 203.4003853 | per 100,000,000 VMT |

Source: 2015 BTS Motor Vehicle Safety Data Table 2-17,
http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_02_17.html

These crash reduction factors were then converted to the Maximum Abbreviated Injury Score (MAIS) crash types in order to apply US DOT Guidance on the value of avoiding a crash. The conversion is based on the National Highway Safety and Traffic Administration (NHTSA) KABCO-AIS Conversion Table (July 2011) provided on page 13 of the TIGER Benefit-Cost Analysis Resource Guide (USDOT 2016)², for Injury (severity unknown), and No Injury crashes. KABCO refers to the letters used to designate five levels of crash severity used by police at a crash scene; AIS refers to the Abbreviated Injury Scale used by hospitals. These factors provide the probability that an injury will range from critical to minor to more accurately capture the total number of different types of injuries associated with the VMT avoided. Estimating the distribution of expected injury types is important because each type of injury has a different associated economic cost.

The total annual value for crash severity is based on USDOT guidance and the National Highway Safety Council estimates for the value of avoiding a crash. These estimates are applied to the number of crashes avoided to estimate the total value of crashes avoided from auto VMT avoided. Exhibit 4 provides the estimated cost of different types of crashes.

Based on the value of accidents avoided, the value of safety incidents avoided due to the reduction in VMT is estimated for each of the facilities and in total. ***The total reduction in highway fatalities and crashes results in \$0.51 million, discounted at 7%.***

State of Good Repair

Roadway Maintenance Savings

A reduction in VMT results in long-term maintenance benefits in the form of roadway maintenance savings, such as painting and paving. The BCA estimates the roadway maintenance cost per VMT at \$0.14³. ***Roadway Maintenance Savings amount to \$0.29 million, discounted at 7%.***

Residual Value

Construction of the new and expanded facilities would have residual value after the end of the 20-year analysis period, because the useful life of these elements is longer than 20 years. Buildings have a useful life of 36 years⁴, and as a result the remaining value was depreciated straight-line for 16 years after the analysis period and discounted at 7 percent and 3 percent. Land does not depreciate, so the undiscounted value of the land acquired for the Project was also included in the residual analysis, as applicable. The remaining discounted value of the buildings was summed with the undiscounted value of the land acquired. ***The value of the remaining useful life for the Project discounted at 7 percent is \$1.65 million.***

² TIGER Benefit-Cost Analysis Resource Guide (updated March 1, 2016), <https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202016.pdf>

³ Kitamura, Ryuichi, Huichun Zhao, A. R. Gibby (1989) Development of a Pavement Maintenance Cost Allocation Model. Institute of Transportation Studies, University of California, Davis, Research Report UCD-ITS-RR-89-03, http://www.its.ucdavis.edu/research/publications/publication-detail/?pub_id=19

⁴ BEA Rate of Depreciation, Service Lives, Declining-Balance Rates, and Hulten-Wyckoff Categories, http://www.bea.gov/scb/account_articles/national/wlth2594/tableC.htm

Environmental Sustainability

Vehicle Emission Reduction Savings

The reduction in VMT will result in a reduction in emissions. The Emissions Savings (VOC, NOx, and PM2.5) were estimated using emissions rates from USDOT guidance⁵ for automobiles. This is conservative because the guidance does not contain emissions rates of transit vans, and if the analysis used emissions rates for diesel transit buses, then the emissions reductions would be overstated. In reality, the results would likely fall somewhere between transit buses and automobiles. The rates are shown in Exhibit 4 and vary over time as vehicle efficiencies improve. The tons of emissions reduced were monetized using the recommended value of emissions from TIGER 2017 guidance.⁶

In total, the project results in emissions savings of \$0.02 million, discounted at 7 percent.

In addition to VOC, NOx, and PM2.5 reductions, carbon dioxide (CO2) or greenhouse gas would also be reduced. Because there is no official guidance on the value of CO2 emissions, this benefit is not quantified in the analysis.

Economic Competitiveness

Cost of Trips Turned Away

The counties are already at maximum operating capacity based on their current facilities. As such, they are handling the maximum number of request for rides that they can accommodate in their existing facility. Without the new or expanded facilities, the counties would have to turn away future trips, and many are already doing this. When trips are turned away, the county must still cover the cost of the trip for the rider on whatever alternate service they use, such as a taxi. Riders often must also pay a portion of that trip.

Based on discussions with the counties, it was found that Anson, Johnston, and Macon Counties are already turning away trips, and Duplin, Hoke, and Iredell Counties expect to begin turning away trips within two to five years from today. If the trips were accommodated in-house, it would result in costs avoided for the agencies. The new and expanded facilities would allow the agencies to hire additional dispatchers and administrative personnel to take the calls and serve more riders.

The analysis is based on actual costs incurred by Anson and Johnston Counties, and estimated numbers of trips turned away from Macon County:

- In 2016, Anson and Johnston Counties reimbursed other providers \$150,445 and \$180,000 per year for trips that they were unable to accommodate. Based on Johnston County's cost reimbursed per demand response trip served in FY2016,⁷ the future estimated costs of reimbursing in Duplin, Hoke, and Iredell were estimated. These estimates are summarized in Exhibit 7. Johnston County was used because its cost per trip is lower than Anson County and therefore the analysis is conservative. Anson and Johnston County costs from 2016 were

⁵ USDOT, Federal Transit Administration, New and Small Starts Evaluation and Rating Process Final Policy Guidance, August 2013

⁶ See TIGER 2017 Notice of Funding Opportunity,
<https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/tiger/114796/fy17-tiger-fedreg.pdf>

⁷ Johnston County FY2016 OpStats

applied in 2021 without escalation. The annual costs avoided are estimated to grow based on the growth rate of the elderly population in the county, as found from the UNC Demographer's Office in Exhibit 4.

Exhibit 7 – Cost of Trips Turned Away, 2021

| | Anson | Duplin | Hoke | Iredell | Johnston |
|---|-----------|----------|-----------|-----------|-----------|
| Cost Reimbursed | \$150,445 | \$76,403 | \$112,013 | \$134,513 | \$180,000 |
| Cost Reimbursed per Demand Response Trip Served | \$4.72 | \$1.87 | \$1.87 | \$1.87 | \$1.87 |

Note: Duplin, Hoke, and Iredell costs are based off of Johnston County's cost reimbursed per demand response trip served

- Macon County turns away 100 trips per year. Valued at \$35 per trip, \$30 is assumed to be the average fully-allocated cost of a trip for the counties, and \$5 for the passenger out of pocket. The annual costs avoided are estimated to grow based on the growth rate of the elderly population in the county, as found from the UNC Demographer's Office in Exhibit 4.

In total, the project results in a savings of \$6.74 million from costs turned away, discounted at 7 percent.

Lease Avoided

Anson and Iredell Counties currently pay leases or mortgages to operate in their facilities. Anson County pays 22,560 per month, increasing at 5 percent per month, and Iredell has a \$250,000 mortgage over 10 years, assumed to begin at the beginning of the analysis period. The new facilities would be owned outright, saving monthly costs. ***In total, the project results in \$0.43 million of leases avoided discounted at 7 percent.***

Dispatch Efficiency

With improved on-site circulation, the agencies would realize small efficiency gains in parking, circulation, and dispatch operations on-site. These small gains are estimated in Duplin County's Feasibility Study, where driver inefficiency was valued at \$3,750 per year and savings on preventive maintenance time was valued at \$5,850 per year. Estimating that the remaining agencies would also save some time from more efficient dispatching and circulation on site, a conservative 5 minutes per vehicle per day was estimated and held constant throughout the analysis period. The time is valued by the hourly operating cost for the agencies as estimated from their OpStats reports. ***In total, the project results in dispatch efficiency savings \$0.36 million discounted at 7 percent.***

Wash Savings

Anson and Duplin Counties are expecting to construct wash bays on-site, which will allow them to wash vehicles at a savings compared to the current location. As part of the Duplin County Public Transportation Facility Feasibility Study,⁸ Duplin County estimated their annual wash savings at \$28,000. Anson County estimates a savings of \$750 per month by washing the vehicles in-house, totaling \$9,000 per year. ***In total, the project results in wash savings of \$0.32 million, discounted at 7 percent.***

⁸ Duplin County Public Transportation Facility Feasibility Study, 2016

Congestion Cost Savings

A reduction in VMT reduces congestion for the remaining drivers. The congestion cost savings was monetized using the FHWA Value of Congestion per VMT and is \$0.077 cents per mile in 2000. ***Converting to 2017 dollars and multiplying by the annual VMT avoided, congestion cost savings amount to \$0.22 million for the project discounted at 7 percent.***

Vehicle Operating Cost Savings

Operating cost savings can include reduced operating costs for the agency when VMT is reduced from more efficient operations. The BCA uses a cost savings per reduced VMT that varies by county, based on the total operating costs per mile for demand response service, using each county's FY2016 OpStats database. The costs per VMT are found in Exhibit 4, and depreciation was added. Depreciation was estimated based on FTA Useful Life of transit vans of 100,000 miles. Based on the average purchase cost of Johnston County transit vehicles of \$66,250, depreciation was valued at \$0.66 per mile.

Vehicle operating cost savings amount to \$4.09 million for the project, discounted at 7 percent.

Quality of Life

Although not quantified in the BCA, there are qualitative benefits to the project in the forms of adequate working space and safer working environments.

Benefit of Adequate Workspace

At their current locations, many employees do not have adequate desk space or privacy with which to work. In addition, the drivers do not have space to congregate in the mornings to hear safety briefings or other updates, nor do they have locker space to store their personal items or to change after a shift. This lack of space results in inefficiencies for the daily operations, and also limits the camaraderie that could be achieved if employees had a break room or space to eat lunches together on site. As a result of the difficulty in quantifying this benefit, it was not quantified in the analysis.

Benefit of Safety at Work

Safety of the new facility is important. Due to the current facilities' locations in less desirable areas, employees are concerned when arriving for shifts in the very early morning hours or when they leave after dark. Some employees have even been approached in situations that left them scared and unsettled. Due to the difficulty of quantifying the dollar value of avoiding this situation, it was not quantified in the analysis.

In addition, Iredell County employees face a risk of methane poisoning because the current location is in a condemned house adjacent to a dump. The house contains methane detectors, which, when activated, indicate an unsafe working environment for the employees. This is an unnecessary risk to the health and safety of the employees, but due to the difficulty in quantifying the value of the benefit, it was not included in the analysis.

Costs

Capital Costs

The capital costs for the Project include the costs for the purchase of land, construction, and soft costs including project management (PM) and architectural and engineering (A&E) services. The costs of each county's facility are shown in Exhibit 8.

Exhibit 8 – Construction Costs for Each County, 2017\$

| | Anson | Duplin | Hoke | Iredell | Johnston | Macon |
|------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------------------|
| Land | \$0 | \$0 | \$138,088 | \$900,000 | \$0 | \$0 |
| Construction | \$1,100,000 | \$1,250,000 | \$1,700,000 | \$2,000,000 | \$2,450,000 | \$250,000 |
| <i>Construction Subtotal</i> | <i>\$1,100,000</i> | <i>\$1,250,000</i> | <i>\$1,838,088</i> | <i>\$2,900,000</i> | <i>\$2,450,000</i> | <i>\$250,000</i> |
| PM | \$110,000 | \$125,000 | \$183,809 | \$290,000 | \$245,000 | \$80,000 |
| A&E | \$132,000 | \$150,000 | \$220,571 | \$348,000 | \$294,000 | \$30,000 |
| Total | \$1,342,000 | \$1,525,000 | \$2,242,467 | \$3,538,000 | \$2,989,000 | \$360,000 |

The capital costs are applied over the one year construction period, beginning and ending in 2020. ***The capital costs for the project discounted at 7 percent total to \$9.79 million.***

Operating and Maintenance Costs

The project requires annual and periodic operating and maintenance (O&M) costs to keep the new and expanded facilities in a state of good repair. Maintenance of the buildings begins in 2021, as the first full year of operation, and the O&M costs for Hoke and Iredell were estimated based on the data provided by Anson, Duplin, Johnston, and Macon Counties, shown in Exhibit 9. The O&M costs for Hoke and Iredell Counties were estimated based on the average change in O&M per square foot from the four counties that provided estimates.

Exhibit 9 – Net New O&M by County

| | Anson | Duplin | Hoke | Iredell | Johnston | Macon |
|-------------------------------|----------|--------|-----------|---------|----------|--------|
| Estimated O&M | -\$1,466 | \$775 | see below | | \$8,200 | \$100 |
| SF | 3,482 | 3,323 | 3,500 | 7,200 | 7,200 | 1,200 |
| Change in O&M per SF | -\$0.42 | \$0.23 | | | \$1.14 | \$0.08 |
| Average change in O&M per Sf | \$0.26 | | | | | |
| Net New O&M based on SF costs | | | \$905 | \$1,862 | | |

The O&M is net new, considering the savings resulting from more energy efficient buildings but also considering that the facilities will be larger. ***The total O&M costs over the analysis period and discounting at 7 percent is \$0.09 million.***

Summary

Exhibit 10 through Exhibit 16 summarizes the discounted value of the benefits discussed in this memorandum for all of the facilities at an aggregate level and individual level. Taken in total and using a 7 percent discount rate, the benefits provide \$14.64 million dollars of benefits over the analysis period. Compared to a similarly discounted cost estimate, the Benefit Cost Ratio for the Project is 1.49, an excellent return on these critical investments for the rural counties. The net benefits total \$4.84 million. Each of the counties also has a Benefit Cost Ratio over 1.0, illustrating that the program has more benefits in part and in total than costs. The total program is shown in Exhibit 10.

Exhibit 10 -Total Program Benefit-Cost Analysis

| | | All Facilities | |
|---|--|-------------------------------------|------------------|
| | | 20 Year Analysis Period (2021-2040) | |
| | | Values stated in 2017 \$M | |
| | | Discounted at 7% | Discounted at 3% |
| Costs | | | |
| Capital Costs | | \$9.79 | \$10.98 |
| Total Costs | | \$9.79 | \$10.98 |
| Benefits | | | |
| Safety Benefits | | | |
| Reduced Roadway Fatalities and Crashes | | \$0.51 | \$0.85 |
| Sub-Total Safety Benefits | | \$0.51 | \$0.85 |
| State of Good Repair | | | |
| Roadway Maintenance Savings | | \$0.29 | \$0.47 |
| Residual Value | | \$1.65 | \$2.57 |
| Sub-Total State of Good Repair | | \$1.94 | \$3.04 |
| Environmental Sustainability | | | |
| Emissions Savings | | \$0.02 | \$0.03 |
| Sub-Total Environmental Sustainability | | \$0.02 | \$0.03 |
| Economic Competitiveness | | | |
| Costs of Trips Turned Away | | \$6.74 | \$10.90 |
| Lease Avoided | | \$0.43 | \$0.68 |
| Dispatch Efficiency | | \$0.46 | \$0.73 |
| Wash Savings | | \$0.32 | \$0.50 |
| Congestion Savings | | \$0.22 | \$0.35 |
| Vehicle Operating Cost Savings | | \$4.09 | \$6.62 |
| Sub-Total Economic Competitiveness | | \$12.26 | \$19.79 |
| Quality of Life | | | |
| See discussion of qualitative benefits in tech memo | | | |
| Sub-Total Quality of Life | | \$0.00 | \$0.00 |
| O&M Costs | | \$0.09 | \$0.14 |
| Net O&M | | \$0.09 | \$0.14 |
| Total Benefits | | \$14.64 | \$23.56 |
| BC Ratio | | 1.49 | 2.15 |
| Net Benefits | | \$4.84 | \$12.58 |

Exhibit 11 - Anson County Benefit-Cost Analysis

| | Anson County | |
|---|-------------------------------------|------------------|
| | 20 Year Analysis Period (2021-2040) | |
| | Values stated in 2017 \$M | |
| | Discounted at 7% | Discounted at 3% |
| Costs | | |
| Capital Costs | \$1.10 | \$1.23 |
| Total Costs | \$1.10 | \$1.23 |
| Benefits | | |
| Safety Benefits | | |
| Reduced Roadway Fatalities and Crashes | \$0.06 | \$0.09 |
| Sub-Total Safety Benefits | \$0.06 | \$0.09 |
| State of Good Repair | | |
| Roadway Maintenance Savings | \$0.03 | \$0.05 |
| Residual Value | \$0.08 | \$0.19 |
| Sub-Total State of Good Repair | \$0.11 | \$0.24 |
| Environmental Sustainability | | |
| Emissions Savings | \$0.00 | \$0.00 |
| Sub-Total Environmental Sustainability | \$0.00 | \$0.00 |
| Economic Competitiveness | | |
| Costs of Trips Turned Away | \$1.40 | \$2.23 |
| Lease Avoided | \$0.29 | \$0.48 |
| Dispatch Efficiency | \$0.05 | \$0.07 |
| Wash Savings | \$0.08 | \$0.12 |
| Congestion Savings | \$0.02 | \$0.04 |
| Vehicle Operating Cost Savings | \$0.50 | \$0.79 |
| Sub-Total Economic Competitiveness | \$2.34 | \$3.75 |
| Quality of Life | | |
| See discussion of qualitative benefits in tech memo | | |
| Sub-Total Quality of Life | \$0.00 | \$0.00 |
| O&M Costs | -\$0.01 | -\$0.02 |
| Net O&M | -\$0.01 | -\$0.02 |
| Total Benefits | \$2.52 | \$4.10 |
| BC Ratio | 2.30 | 3.34 |
| Net Benefits | \$1.42 | \$2.88 |

Exhibit 12 - Duplin County Benefit-Cost Analysis

| | Duplin County | |
|---|-------------------------------------|------------------|
| | 20 Year Analysis Period (2021-2040) | |
| | Values stated in 2017 \$M | |
| | Discounted at 7% | Discounted at 3% |
| Costs | | |
| Capital Costs | \$1.24 | \$1.40 |
| Total Costs | \$1.24 | \$1.40 |
| Benefits | | |
| Safety Benefits | | |
| Reduced Roadway Fatalities and Crashes | \$0.06 | \$0.09 |
| Sub-Total Safety Benefits | \$0.06 | \$0.09 |
| State of Good Repair | | |
| Roadway Maintenance Savings | \$0.03 | \$0.05 |
| Residual Value | \$0.09 | \$0.22 |
| Sub-Total State of Good Repair | \$0.12 | \$0.27 |
| Environmental Sustainability | | |
| Emissions Savings | \$0.00 | \$0.00 |
| Sub-Total Environmental Sustainability | \$0.00 | \$0.00 |
| Economic Competitiveness | | |
| Costs of Trips Turned Away | \$0.79 | \$1.27 |
| Lease Avoided | \$0.00 | \$0.00 |
| Dispatch Efficiency | \$0.08 | \$0.13 |
| Wash Savings | \$0.24 | \$0.38 |
| Congestion Savings | \$0.02 | \$0.04 |
| Vehicle Operating Cost Savings | \$0.33 | \$0.54 |
| Sub-Total Economic Competitiveness | \$1.47 | \$2.36 |
| Quality of Life | | |
| See discussion of qualitative benefits in tech memo | | |
| Sub-Total Quality of Life | \$0.00 | \$0.00 |
| O&M Costs | \$0.01 | \$0.01 |
| Net O&M | \$0.01 | \$0.01 |
| Total Benefits | \$1.64 | \$2.71 |
| BC Ratio | 1.31 | 1.95 |
| Net Benefits | \$0.39 | \$1.32 |

Exhibit 13 - Hoke County Benefit-Cost Analysis

| | Hoke County | |
|---|-------------------------------------|------------------|
| | 20 Year Analysis Period (2021-2040) | |
| | Values stated in 2017 \$M | |
| | Discounted at 7% | Discounted at 3% |
| Costs | | |
| Capital Costs | \$1.83 | \$2.05 |
| Total Costs | \$1.83 | \$2.05 |
| Benefits | | |
| Safety Benefits | | |
| Reduced Roadway Fatalities and Crashes | \$0.12 | \$0.20 |
| Sub-Total Safety Benefits | \$0.12 | \$0.20 |
| State of Good Repair | | |
| Roadway Maintenance Savings | \$0.07 | \$0.11 |
| Residual Value | \$0.26 | \$0.44 |
| Sub-Total State of Good Repair | \$0.33 | \$0.55 |
| Environmental Sustainability | | |
| Emissions Savings | \$0.00 | \$0.01 |
| Sub-Total Environmental Sustainability | \$0.00 | \$0.01 |
| Economic Competitiveness | | |
| Costs of Trips Turned Away | \$1.23 | \$2.02 |
| Lease Avoided | \$0.00 | \$0.00 |
| Dispatch Efficiency | \$0.07 | \$0.11 |
| Wash Savings | \$0.00 | \$0.00 |
| Congestion Savings | \$0.05 | \$0.08 |
| Vehicle Operating Cost Savings | \$1.07 | \$1.74 |
| Sub-Total Economic Competitiveness | \$2.42 | \$3.95 |
| Quality of Life | | |
| See discussion of qualitative benefits in tech memo | | |
| Sub-Total Quality of Life | \$0.00 | \$0.00 |
| O&M Costs | \$0.01 | \$0.01 |
| Net O&M | \$0.01 | \$0.01 |
| Total Benefits | \$2.86 | \$4.70 |
| BC Ratio | 1.56 | 2.29 |
| Net Benefits | \$1.03 | \$2.65 |

Exhibit 14 - Iredell County Benefit-Cost Analysis

| | Iredell County | |
|--------------------|-------------------------------------|------------------|
| | 20 Year Analysis Period (2021-2040) | |
| | Values stated in 2017 \$M | |
| | Discounted at 7% | Discounted at 3% |
| Costs | | |
| Capital Costs | \$2.89 | \$3.24 |
| Total Costs | \$2.89 | \$3.24 |

| Benefits | | |
|---|---------------|---------------|
| Safety Benefits | | |
| Reduced Roadway Fatalities and Crashes | \$0.13 | \$0.22 |
| Sub-Total Safety Benefits | \$0.13 | \$0.22 |
| State of Good Repair | | |
| Roadway Maintenance Savings | \$0.07 | \$0.12 |
| Residual Value | \$1.04 | \$1.25 |
| Sub-Total State of Good Repair | \$1.12 | \$1.37 |
| Environmental Sustainability | | |
| Emissions Savings | \$0.00 | \$0.01 |
| Sub-Total Environmental Sustainability | \$0.00 | \$0.01 |
| Economic Competitiveness | | |
| Costs of Trips Turned Away | \$1.37 | \$2.22 |
| Lease Avoided | \$0.14 | \$0.20 |
| Dispatch Efficiency | \$0.11 | \$0.17 |
| Wash Savings | \$0.00 | \$0.00 |
| Congestion Savings | \$0.06 | \$0.09 |
| Vehicle Operating Cost Savings | \$1.07 | \$1.73 |
| Sub-Total Economic Competitiveness | \$2.75 | \$4.40 |
| Quality of Life | | |
| See discussion of qualitative benefits in tech memo | | |
| Sub-Total Quality of Life | \$0.00 | \$0.00 |

| | | |
|--------------------|---------------|---------------|
| O&M Costs | \$0.02 | \$0.03 |
| Net O&M | \$0.02 | \$0.03 |

| | | |
|-----------------------|---------------|---------------|
| Total Benefits | \$3.98 | \$5.97 |
|-----------------------|---------------|---------------|

| | | |
|---------------------|---------------|---------------|
| BC Ratio | 1.38 | 1.84 |
| Net Benefits | \$1.09 | \$2.73 |

Exhibit 15 - Johnston County Benefit-Cost Analysis

| | Johnston County | |
|--------------------|-------------------------------------|------------------|
| | 20 Year Analysis Period (2021-2040) | |
| | Values stated in 2017 \$M | |
| | Discounted at 7% | Discounted at 3% |
| Costs | | |
| Capital Costs | \$2.44 | \$2.74 |
| Total Costs | \$2.44 | \$2.74 |

| Benefits | | |
|---|---------------|---------------|
| Safety Benefits | | |
| Reduced Roadway Fatalities and Crashes | \$0.09 | \$0.14 |
| Sub-Total Safety Benefits | \$0.09 | \$0.14 |
| State of Good Repair | | |
| Roadway Maintenance Savings | \$0.05 | \$0.08 |
| Residual Value | \$0.17 | \$0.43 |
| Sub-Total State of Good Repair | \$0.22 | \$0.51 |
| Environmental Sustainability | | |
| Emissions Savings | \$0.00 | \$0.00 |
| Sub-Total Environmental Sustainability | \$0.00 | \$0.00 |
| Economic Competitiveness | | |
| Costs of Trips Turned Away | \$1.91 | \$3.11 |
| Lease Avoided | \$0.00 | \$0.00 |
| Dispatch Efficiency | \$0.11 | \$0.17 |
| Wash Savings | \$0.00 | \$0.00 |
| Congestion Savings | \$0.04 | \$0.06 |
| Vehicle Operating Cost Savings | \$0.66 | \$1.08 |
| Sub-Total Economic Competitiveness | \$2.72 | \$4.41 |
| Quality of Life | | |
| See discussion of qualitative benefits in tech memo | | |
| Sub-Total Quality of Life | \$0.00 | \$0.00 |

| | | |
|--------------------|---------------|---------------|
| O&M Costs | \$0.07 | \$0.11 |
| Net O&M | \$0.07 | \$0.11 |

| | | |
|-----------------------|---------------|---------------|
| Total Benefits | \$2.95 | \$4.96 |
|-----------------------|---------------|---------------|

| | | |
|---------------------|---------------|---------------|
| BC Ratio | 1.21 | 1.81 |
| Net Benefits | \$0.51 | \$2.22 |

Exhibit 16 - Macon County Benefit-Cost Analysis

| | Macon County | |
|--------------------|-------------------------------------|------------------|
| | 20 Year Analysis Period (2021-2040) | |
| | Values stated in 2017 \$M | |
| | Discounted at 7% | Discounted at 3% |
| Costs | | |
| Capital Costs | \$0.29 | \$0.33 |
| Total Costs | \$0.29 | \$0.33 |

| Benefits | | |
|---|---------------|---------------|
| Safety Benefits | | |
| Reduced Roadway Fatalities and Crashes | \$0.06 | \$0.10 |
| Sub-Total Safety Benefits | \$0.06 | \$0.10 |
| State of Good Repair | | |
| Roadway Maintenance Savings | \$0.03 | \$0.05 |
| Residual Value | \$0.02 | \$0.04 |
| Sub-Total State of Good Repair | \$0.05 | \$0.10 |
| Environmental Sustainability | | |
| Emissions Savings | \$0.00 | \$0.00 |
| Sub-Total Environmental Sustainability | \$0.00 | \$0.00 |
| Economic Competitiveness | | |
| Costs of Trips Turned Away | \$0.03 | \$0.05 |
| Lease Avoided | \$0.00 | \$0.00 |
| Dispatch Efficiency | \$0.05 | \$0.08 |
| Wash Savings | \$0.00 | \$0.00 |
| Congestion Savings | \$0.03 | \$0.04 |
| Vehicle Operating Cost Savings | \$0.47 | \$0.74 |
| Sub-Total Economic Competitiveness | \$0.57 | \$0.91 |
| Quality of Life | | |
| See discussion of qualitative benefits in tech memo | | |
| Sub-Total Quality of Life | \$0.00 | \$0.00 |

| | | |
|--------------------|---------------|---------------|
| O&M Costs | \$0.00 | \$0.00 |
| Net O&M | \$0.00 | \$0.00 |

| | | |
|-----------------------|---------------|---------------|
| Total Benefits | \$0.68 | \$1.11 |
|-----------------------|---------------|---------------|

| | | |
|---------------------|---------------|---------------|
| BC Ratio | 2.33 | 3.37 |
| Net Benefits | \$0.39 | \$0.78 |

List of Supporting Information

AECOM, NCDOT_PTD_TIGER2017.xls (Excel spreadsheet with BCA calculations by benefit type and summary)

Bureau of Economic Analysis Rate of Depreciation, Service Lives, Declining-Balance Rates, and Hulten-Wyckoff Categories, http://www.bea.gov/scb/account_articles/national/wlth2594/tableC.htm

Federal Transit Administration Circulator 5010.1D Grant Management Requirements 2008, <https://cms.fta.dot.gov/funding/grant-programs/capital-investments/fta-circular-50101d-november-2008>

Kitamura, Ryuichi, Huichun Zhao, A. R. Gibby (1989) Development of a Pavement Maintenance Cost Allocation Model. Institute of Transportation Studies, University of California, Davis, Research Report UCD-ITS-RR-89-03, http://www.its.ucdavis.edu/research/publications/publication-detail/?pub_id=19

TIGER 2017 Notice of Funding Opportunity, <https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/tiger/114796/fy17-tiger-fedreg.pdf>

TIGER and INFRA 2017 Benefit-Cost Analysis Resource Guide, <https://www.transportation.gov/sites/dot.gov/files/docs/mission/office-policy/transportation-policy/284031/benefit-cost-analysis-guidance-2017.pdf>

TIGER Benefit-Cost Analysis Resource Guide (updated March 1, 2016), <https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202016.pdf>

USDOT, Federal Transit Administration, New and Small Starts Evaluation and Rating Process Final Policy Guidance, August 2013

NCDOT Operating Statistics for Fiscal Year 2016:

Anson County FY2016 OpStats

Duplin County FY2016 OpStats

Hoke County FY2016 OpStats

Iredell County FY2016 OpStats

Johnston County FY2016 OpStats

Macon County FY2016 OpStats

NCDOT Feasibility Studies:

Anson County Transportation System Facility Feasibility Study, 2016

Duplin County Public Transportation Facility Feasibility Study, 2016

Hoke Area Transit Service Transit Facility Feasibility Study, 2015

Johnston County Area Transit System Facility Feasibility Study, 2017